Flexcell® Flex Jr.™ Tension System

12-15-14
Rev 10.1

Culturing Cells in a Mechanically Active Environment™

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ONE YEAR LIMITED PARTS WARRANTY
Flexcell® Flex Jr.™ Tension System

1. **FLEXCELL INTERNATIONAL CORPORATION** warrants to the original purchaser/customer all hardware components of the **Flexcell® Flex Jr.™ Tension System** serial #_____for a period of one year from the date of delivery to the purchaser/customer to be free from manufacturing defects in workmanship or materials with the following exceptions, terms and conditions:

    a. ITEMS EXCLUDED FROM THE WARRANTY ARE: Dell OptiPlex desktop computer and monitor*, software, disks, manuals and external peripherals such as printers, mouse or track ball units, imaging devices, vacuum pumps, air tanks, electric voltage converters, compressors, surge suppressers and all other accessory equipment.

    b. DURING THE WARRANTY PERIOD, the purchaser/customer must notify Flexcell of any warranty claim in writing, by telephone, fax transmission or email identifying each defective part or specifically describe the exact problem no later than the last day the warranty is in effect.

    c. FLEXCELL AGREES to correct any defect in workmanship or material and supply new or rebuilt parts in exchange for defective parts upon completion and submission by purchaser/customer of a printed "Parts Return Authorization" form furnished by Flexcell. Parts must be properly packed in original container and shipped to our factory service center or distributor with all shipping costs prepaid if the unit is out of warranty coverage. If the original shipping box is not available, Flexcell will send the required protective shipping container. (Flexcell will recommend the insurance value for parts or equipment to be shipped.) Return carrier shipping costs will be paid by Flexcell from the service center. The purchaser/customer is solely responsible for payment of custom fees, taxes, holding fees or value added taxes.

    d. THIS LIMITED WARRANTY only covers failures due to defects in materials or workmanship which occur during normal use. It does not cover damage which occurs in shipment or failures of original equipment due to products identified as add-ons not manufactured by Flexcell International Corporation or its distributors nor does this limited warranty cover damages or failures which result from accident or disaster such as fire, explosion, flood, wind, lightning, or earthquake or misuse, abuse, neglect, mishandling, misapplication, alteration, faulty installation, modification or service by anyone other than our factory or distributor. Breaking the seal and opening the unit case or violating unit components will void the warranty. This warranty is extended only to the original purchaser/customer unless a transfer of ownership is approved by Flexcell in writing.

    e. LIMITED LIABILITY. Flexcell or its distributor's only liability shall be to remedy any defect to comply with its warranty and return the repaired equipment to function as designed. Under no circumstances shall Flexcell or its distributors be liable for any special incidental or consequential damages based upon breach of warranty or contract or negligence. Such damages include, but are not limited to: loss of profits, revenue, loss of data, down time, customer's material or time.

    f. DISCLAIMER OF WARRANTIES: The Limited Warranty expressed in the foregoing language is the only warranty applicable to this product. Any other warranty, expressed or implied warranty or of merchantability or fitness for a particular purpose are hereby disclaimed. No oral or written information or advice provided by Flexcell, through its agents or employees, in the use and functioning of the equipment shall in any way create a warranty or in anyway increase the scope of this limited warranty.

    g. DISCLAIMER: LANGUAGE. This warranty document, accompanying instruction manual and supplemental applicable laws appear in the English language. In the event of any inconsistency in the meaning of the words and terminology and any foreign language translation, the English language shall prevail.

2. GOVERNING LAW. The performance of the duties and liabilities of the parties under the terms and conditions of this Limited Warranty shall be governed in all respects by the laws of the State of North Carolina, the United States of America.

    APPLICATION OF STATE LAWS: Some states do not allow the exclusion or limitation of consequential damages nor do some states allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you. This warranty gives you specific legal rights and you may also have other rights that vary from state to state.

3. INTERNATIONAL CUSTOMERS. The full text of the foregoing limited warranty and all disclaimers is applicable to international customers/purchasers except when the purchase was made from an international distributor or reseller, the warranty will be covered through your distributor or reseller.

    If technical advisory support service is not available through your distributor or reseller, for service contact warranty headquarters by phone or fax.

Within the United States only: 1-800-728-3714 (toll free) - Fax: 1-919-732-5196
International Customer's telephone: 01-919-732-1591 - Fax: 01-919-732-5196
Email: info@flexcellint.com

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**Customers should contact Dell Inc. for all warranty questions or concerns with regards to the Dell OptiPlex computer and monitor.*

Dell COMPUTER WARRANTY INFORMATION

Dear Customer:

Congratulations on your purchase of the Flexcell® Flex Jr.™ system. This system comes with a one (1) year warranty. The Dell computer that is included with this equipment will be transferred into the Principal Investigator and University's name at the time of purchase. This computer comes with an excellent warranty through Dell. If you have any problems with this computer, you will contact Dell directly. The details of the warranty are listed below. You will need to have the service tag number and Express Service Code number, which are located on the side of the computer.

- Dell Hardware Limited Warranty Plus Onsite Service Extended Year
- Dell Hardware Limited Warranty Plus Onsite Service Initial Year
- Thank you choosing Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-866-516-3115
- ProSupport for IT: Next Business Day Parts and Labor Onsite Response 2 Year Extended
- ProSupport for IT: Next Business Day Parts and Labor Onsite Response Initial Year
- ProSupport for IT: 7x24 Technical Support for certified IT Staff, 2 Year Extended
- ProSupport for IT: 7x24 Technical Support for certified IT Staff, Initial year

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE STATEMENT

This computing equipment has been type-tested and found to comply with the limits for a Class B digital device in accordance with the specifications for Subpart J of Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful radio and TV interference in a residential installation. There is no guarantee that interference will not occur in a particular installation.

The following instructions and precautions must be observed by the user when installing and operating this device:

1. The equipment must be operated in strict accordance with the manufacturer's instructions.
2. The unit(s) must be plugged into a properly-grounded power outlet and used with the power cord supplied with the unit(s), unmodified.
3. The unit must be operated with the factory-installed cover in place.
4. No modifications of the equipment can be made which may result in the equipment failing to meet the limits of the FCC Rules.
5. The equipment must be maintained in a satisfactory state of repair.
6. Shielded cables must be used with this equipment to ensure compliance with the FCC Rules.

If the unit interferes with radio or television reception (which can be tested by turning the unit off and on) the user is encouraged to try the following procedure to correct the interference:

1. Reorient the antenna of the receiver.
2. Relocate the equipment to increase the distance between the unit and the radio/TV.
3. Connect the unit to an outlet on a different circuit from the receiver.
4. Consult with the dealer or an experienced radio/TV technician for advice on ways to reduce interference.

Flex Jr.™ QUICK START INSTRUCTIONS

1. Place the computer, monitor, keyboard, mouse and Flex Jr.™ Tension FlexLink® on a sturdy, flat surface.

2. Connect the keyboard, mouse and monitor to the computer according to the manufacturer's instructions.

3. Connect the FlexLink® to the Ethernet port on the back of the computer using the Ethernet cable supplied (see Figs. 2 and 3, p.2).

4. Connect the computer, monitor and FlexLink® to a power source using a surge protector.

5. Connect the system vacuum to the ***SYSTEM*** port on the back of the FlexLink® and check the system vacuum supply (see manual section 2.4 for pump specifications recommendations).

6. Cut two lengths of tubing from those supplied: cut a 10' (3 m) length of the ¼" (6.4 mm) and cut a 10' length of the ⅜" (9.5 mm) tubing. Connect each length of tubing to the rear connection of the FlexLink® in the ***FLEX IN*** and ***FLEX OUT*** ports, accordingly. Attach provided quick disconnects to the other end of each piece of tubing.

7. Place the Water Traps (see Fig. 1, p.2) **inline** with the ***FLEX IN*** and ***FLEX OUT*** tubing:
    a. Make cuts in the tubing for the Water Traps to be positioned as near as possible to the baseplate, outside of the incubator, so that the water will be trapped away from the FlexLink®.
    b. Place the Water Traps at a position below the FlexLink® unit.

8. Connect the tubing to the microscope device (see Fig. 4, p.3):
    a. Connect the short blue tubing provided with the device to the front hose barb on the device.
    b. Connect the quick disconnects at the end of the adapter to the quick disconnect at the end of the ***FLEX IN*** and ***FLEX OUT*** tubing.

9. Turn the FlexLink® and computer system ON. The Windows® desktop should appear on the monitor. Double click on the Flex Jr.™ icon on the left-hand side of the screen to start the software.

10. In the ***Configure*** menu, select ***User Editor*** and register as a user.

11. In the ***Regimen*** menu, select ***Create new*** and create a regimen by entering values into the appropriate spaces or click on the ***Run Wizard*** button in the bottom left-hand corner for a step-by-step procedure. When completed, click on ***Save Regimen***. Exit the regimen editor.

12. In ***Controllers*** menu, select the appropriate FlexLink® number to which the regimen will be downloaded.

13. In the ***Regimen*** menu, select ***Assign.*** Choose the proper platform, user, and regimen **(see section 3.7 for assignment instructions)** from the drop-down menus. Confirm with a ***Yes*** to download the regimen.

14. Once the program is downloaded, click on ***Simulate*** in the main display window. Once satisfied that the regimen is correct, click on ***Stop***.

15. Turn ON the vacuum system. Click on ***Start*** to run the regimen. The membrane should begin flexing. Make a visual check to verify membrane movement.

16. To pause or stop the regimen, click on ***Pause*** or ***Stop*** at any time. Otherwise, the program will stop when the regimen is completed.

17. **Check the Water Traps prior to each experiment** to see if water is accumulating. Empty the Water Traps before they are more than half full.

1. FLEXCELL® FLEX JR.™ TENSION SYSTEM COMPONENTS

1. Dell OptiPlex desktop computer.
   Do not delete any software or change any settings on this computer. It has been pre-configured to operate the FlexSoft® Flex Jr.™ software.

   Preinstalled software:
   FlexSoft® Flex Jr.™
   Microsoft Windows® 7
   Microsoft Office 2010
   Adobe Acrobat

2. Flex Jr.™ Tension FlexLink®
3. USB keyboard
4. USB 2-button entry mouse
5. 17" Flat panel monitor
6. Accessory pack of nuts and ferrules
7. Silicone lubricant
8. System Drying Filter device
9. 25 ft small blue tubing (¼" (6.4 mm) O.D.) for ***FLEX IN*** connection
10. 25 ft clear tubing (⅜" (9.5 mm) O.D.) for ***FLEX OUT*** connection
11. 25 ft large blue tubing (⅜" (9.5 mm) O.D.) for vacuum source connection
12. Flexcell® Flex Jr.™ Tension System user's manual and other ancillary manuals for computer and monitor
13. Surge protected outlet strip
14. Water Trap (x2)
15. Vacuum source (optional)

2. SETUP OF THE FLEXCELL® FLEX JR.™ TENSION SYSTEM

Do not power up the Flexcell® Flex Jr.™ Tension system until all connections among components have been properly made and checked! Never power up the computer or the Flex Jr.™ Tension FlexLink® with the cover removed - an electrical shock hazard exists. Operation of the computer without the cover is in violation of FCC regulations and will void the warranty!

2.1 PACKING LIST

Remove the packing list and check off the instrument components as they are removed from the shipping containers. If any parts are missing, contact Flexcell® International Corp. immediately.

2.2 LOCATION OF THE FLEX JR.™ TENSION SYSTEM

Choose a location for the Flex Jr.™ Tension system (Fig. 1) that is adjacent and as close as possible to the microscope and vacuum source. A shorter distance in vacuum lines decreases the air flow resistance for elongation and release of the flexible bottomed culture plates, allowing for a greater range of flexing at higher frequencies. The length of the vacuum line should be a minimum of 4' (1.2 m). All tubing and the Ethernet communications cable connect to the rear of the ***Flex Jr.™ Tension FlexLink®*** (Fig. 2). All cables (mouse, monitor, keyboard, and Ethernet communications cables) will connect to the rear of the ***computer*** (Fig. 3). The length of the clear and blue tubing from the FlexLink® to the microscope device should be 10' (3 m) long to assure proper system

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performance. This length can vary if needed, but no more than 5' (1.5 m) longer or shorter. Cut the tubing ***after*** the system is fully set up to ensure of the proper length.

The Flex Jr.™ Tension system will require a space 26.75" (64.95 cm) wide by 22.44" (57.00 cm) deep if the computer, Flex Jr.™ Tension FlexLink® and monitor are placed side by side with the keyboard and mouse in front. The total weight of the system is 48.37 lbs (21.96 kg).

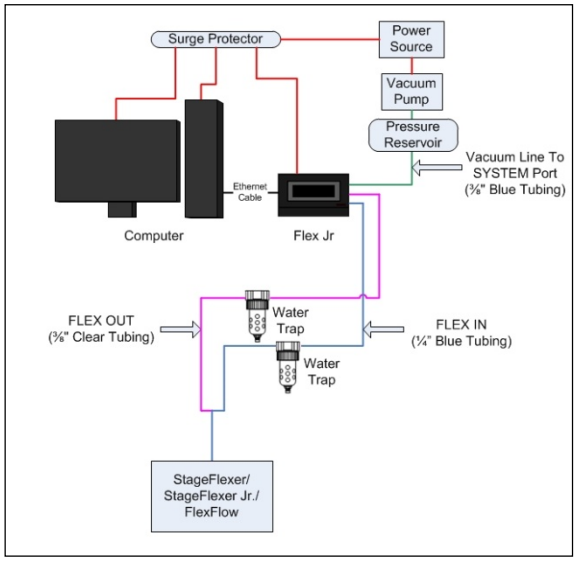


Figure 1. Flexcell® Flex Jr.™ Tension System

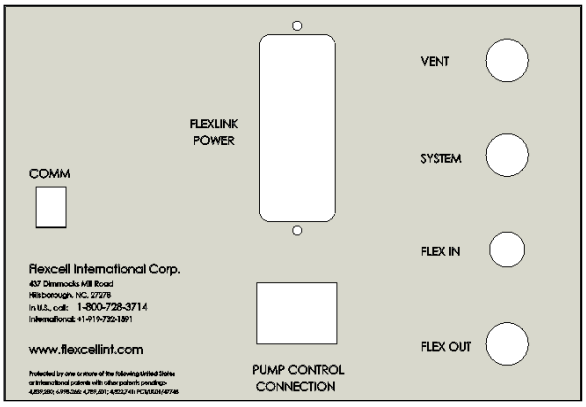


Figure 2. Flex Jr.™ Tension FlexLink® rear view

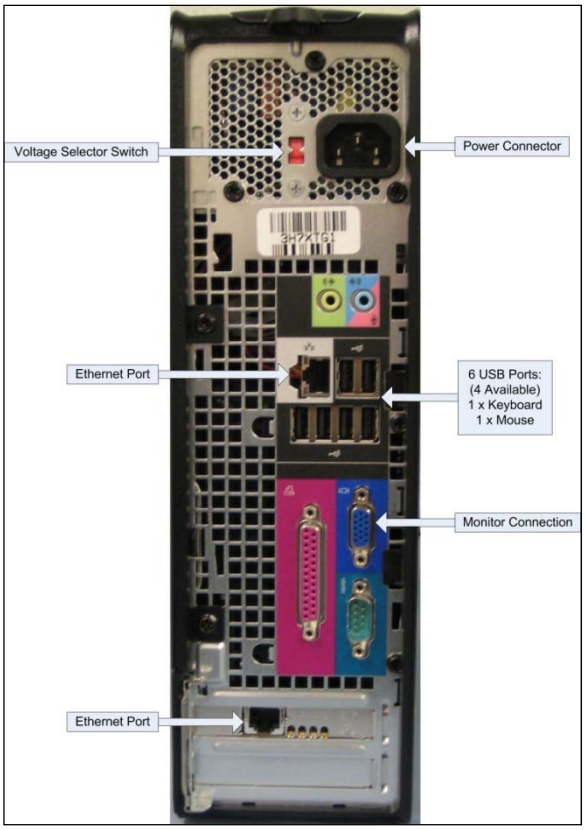


Figure 3. Dell OptiPlex rear view

2.3 SETUP OF THE COMPUTER AND THE FLEX JR.™ TENSION FLEXLINK®

Setup the Dell OptiPlex desktop computer and peripherals according to the manufacturer's instructions. Refer to Figures 1-5 for proper setup of the Flex Jr.™ system instruments. Place the Flex Jr.™ Tension FlexLink® next to the computer and connect the FlexLink® to the computer via the Ethernet cable provided.

If additional FlexLinks® have been purchased, they are to be placed side by side. For multiple FlexLinks® to be controlled by one computer, connect the Ethernet cable from each FlexLink® to an Ethernet hub. Then, connect the hub to the Ethernet port on the back of the computer.

Connect the system tubing as follows:

1. Connect the ⅜" (9.5 mm) O.D. blue tubing from the vacuum source to the ***SYSTEM*** port on the back of the FlexLink® (Fig. 1 & 2).
2. Attach the free end of the clear ⅜" (9.5 mm) tubing to the ***FLEX OUT*** port on the back of the FlexLink® (Fig. 2).
3. Attach the free end of the blue ¼" (6.4 mm) tubing to the ***FLEX IN*** port on the back of the FlexLink® (Fig. 2). The ***VENT*** port should be left open (Fig. 2).
4. Connect a Water Traps inline with the clear ⅜" tubing and the blue ¼" tubing. See the Addendum (p. 17, "B") for further details concerning the placement of the Water Traps.

NOTE: *When connecting the tubing to the back of the FlexLink®, slip the brass nut with the nylon ferrule over the tubing, then push the tubing onto the fitting as far as possible and thread the nut onto the fitting. Tighten each nut* ***by hand*** *until the tubing is crimped to minimize vacuum leakage.*

Connect the power cables (115 VAC or 230 VAC) to the rear power inlet (***FLEXLINK POWER***) of the FlexLink® (Fig. 2). If the available power supply is 115 VAC or 230 VAC, be sure the voltage selection switch on the computer (Fig. 3) is set to 115 V or 230 V, respectively. When the instruments are completely set up, the power cords should be connected to a ***surge protected*** power strip and then to a 115 VAC or 230 VAC, 60 Hz power outlet.

Use the tubing adapter as shown in Figure 4 to connect the Flex Jr.™ to the microscope device. Connect the ¼" (6.4 mm) blue tubing provided with the device to the front hose barb on the device. Then connect the open end to the tubing adapter. Next, connect the ⅜" (9.5 mm) and the ¼" (6.4 mm) quick disconnected tubing, already attached to the adapter, to the respective ***FLEX IN*** and ***FLEX OUT*** tubing from the rear of the Flex Jr.™.

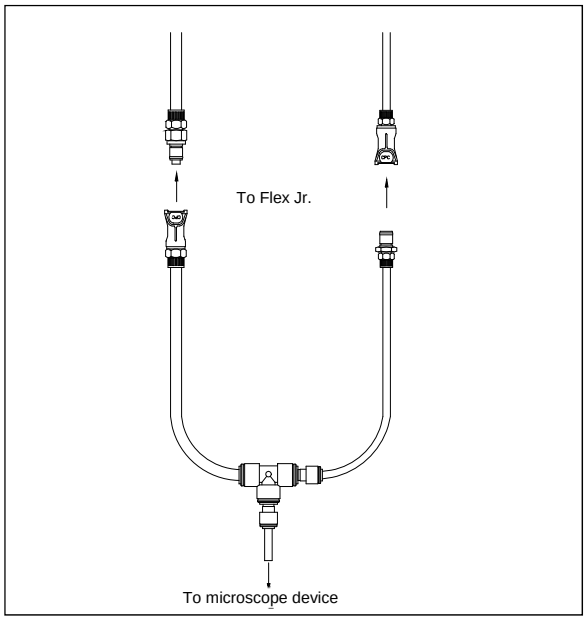


Figure 4. Microscope device to Flex Jr.™ tubing adapter

2.4 CONNECTING THE SYSTEM VACUUM LINES

Connect the blue ⅜" (9.5 mm) vacuum inlet tubing to a vacuum source. A vacuum pump capable of producing a maximum vacuum of -100 kPa and a flow rate of, at least, 5.7 ft^3/min (161 L/min) is necessary for optimal performance.

Keep the tubing length between the vacuum source and FlexLink® as short as possible. Also, keep in mind that some vacuum systems will vary in flow rate and/or pressure level. To eliminate or reduce this effect, use of a pressure reservoir between the vacuum source and the Flex Jr.™ Tension FlexLink® is recommended.

Flexcell® International Corp. recommends the Leybold Trivac D8B Pump vacuum pump (includes the D8B pump system, power cable, gas ballast valve and AR 4-8

return filter) as a vacuum source as well as using a pressure reservoir. The vacuum pump and pressure reservoir can be purchased directly from Flexcell® International Corp.

NOTE: *Even with an optimal vacuum source, there will still be some* ***system limitations*** *due to airflow. Combinations of high frequencies and % elongations may not be achievable due to the high vacuum level in the short period of time requested. The exact output is dependent on many system variables. See the Addendum on page 17 for suggestions on maximizing system performance.*

To use the auto control pump feature, plug the vacuum pump power cable into the ***PUMP CONTROL CONNECTION*** outlet on the rear of the Flex Jr.™ Tension FlexLink® (Fig. 2 and 5).

NOTE: When using the auto pump control feature, the power cable from the Flex Jr.™ Tension FlexLink® must be connected directly into the mains power. Failure to do so will cause damage to the Flex Jr.™ Tension FlexLink®.

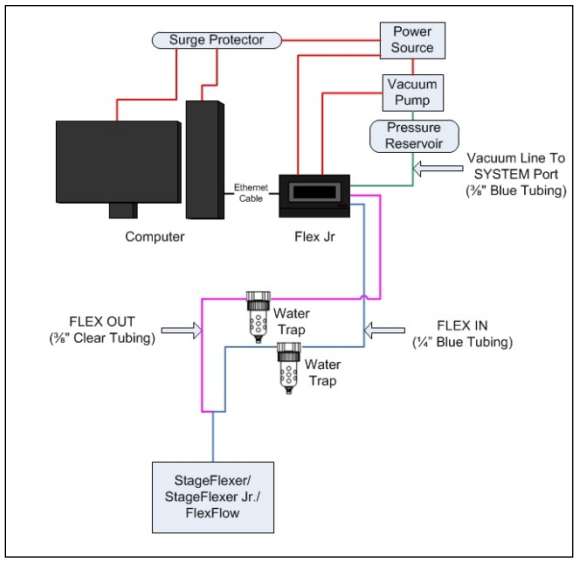


Figure 5. Flexcell® Flex Jr.™ Tension System power set-up with auto control pump feature

See page 14 for additional comments on setting up the vacuum power to use the auto control feature.

2.5 FLEXSOFT® FLEX JR.™ SOFTWARE AND SYSTEM POWER-UP

The FlexSoft® Flex Jr.™ software (Flexcell® Copyright Protected Software, Property of Flexcell® International Corporation, 2730 Tucker Street, Suite 200, Burlington, NC 27215) has been pre-installed on the hard drive.

Keep the CD package included with your system and store it in a safe place. Be sure to shutdown Windows® properly by using the *Shut Down* command activated by the *Start* button. Failure to follow the above directions can cause software and hardware malfunctions.

The computer has Windows® 7 installed on the hard drive. All backup software is provided with the system. Check all connections and connect the surge protector into an appropriate power outlet (115 VAC or 230 VAC). Turn ON the surge protector strip and check that the indicator light on the strip is lit. If the power light does not come on, the surge protector has failed. Replace the surge protector and attempt to determine what caused the surge protector to fail. Turn ON the power switches at the computer, monitor and Flex Jr.™ Tension FlexLink®. The system should then boot and load Windows®. Select and double click on the Flex Jr.™ icon.

NOTE: *Flexcell® recommends that the power saving or screen saver features in the Windows® software are disabled. Allowing the hard drive to power down while an experiment is running may create the need to reboot the computer before data can be viewed, or before a regimen can be downloaded again. It is*

recommended that the monitor be put in "sleep" mode when not in use and that the computer be allowed to run at full power during an experiment.

2.6 LCD DISPLAY ON THE FLEX JR.™ TENSION FLEXLINK®

The front of the Flex Jr.™ Tension FlexLink® box has an LCD graphic display. When the Flex Jr.™ Tension FlexLink® is turned ON, the LCD will display the FlexLink® number (i.e., #1, #2, #3, or #4) and the regimen status (i.e., Idle, Ready, or Left (the time remaining, in minutes, of a running regimen). When a regimen has been downloaded and/or is running, the LCD will also display the user name, platform, and regimen name. See Table 1, below, for the display messages with various FlexLink® statuses.

Table 1. Messages displayed on the Flex Jr.™ Tension FlexLink® LCD.

FlexLink Status	**LCD message**
Power ON	#1 Regimen: Idle Flexcell International Corp. www.flexcellint.com
Regimen downloaded	#1 Regimen: Ready User name Platform Regimen Name Flexcell International Corp. www.flexcellint.com
Regimen is running or being simulated	#1 Regimen: Left 5 min User name Platform Regimen Name Flexcell International Corp. www.flexcellint.com
Regimen has stopped	#1 Regimen: Idle User name Platform Regimen Name Flexcell International Corp. www.flexcellint.com

2.7 USING ADDITIONAL FLEX JR.™ TENSION FLEXLINKS®

Using additional Flex Jr.™ Tension FlexLinks® will allow two or more platforms with different regimens to run simultaneously. All tubing connections made to the first FlexLink® should be made exactly the same with any additional FlexLinks®. Each FlexLink® will have its own separate ***FLEX IN*** and ***FLEX OUT*** tubing for each platform. However, the ***SYSTEM*** tubing can be shared between FlexLinks® with "T" fittings as long as the vacuum source is capable of running two or more FlexLinks® with the programmed regimens. Regimens with a combination of high frequencies and % elongation levels will require a more powerful vacuum source. The capability of the vacuum source with more than one FlexLink® will need to be tested experimentally with the user's particular setup. FlexLinks® must be placed side-by-side during use. If the user desires to use the vacuum pump auto control feature with each FlexLink®, then separate vacuum pumps will need to be used with each FlexLink®.

To connect additional FlexLink®(s) to the computer, connect the Ethernet cable from each FlexLink® to an Ethernet hub. Then, connect the hub to the Ethernet port on the back of the computer using the Ethernet communications cable provided. The LCD on the front of the FlexLink® will display the number (#1-4) that the Flex Jr.™ Tension FlexLink® has been assigned at the time of production.

NOTE: *The numbering of each Flex Jr.™ Tension FlexLink® will not depend on what order it appears in the connection chain, but according to the configuration of each FlexLink® as "FlexLink #1, FlexLink #2…etc" during production.*

When powering up the FlexLink®(s) and computer, turn the FlexLink®(s) ON before the computer. To use a particular FlexLink®, select the appropriate FlexLink® number (#1, 2, 3, or 4) from the *Controllers* menu. Assign, download, and run regimens just as would be done when using one FlexLink®.

3. OPERATION INSTRUCTIONS

3.1 STARTING THE FLEX JR.™ PROGRAM

The Flexcell® system should now be set up and ready for operation. Be sure that the system vacuum supply is adequate to operate the instrument(s) (see section 2.4).

Turn ON the power switch on the computer, monitor and Flex Jr.™ Tension FlexLink®. The system should then boot and load Windows®. Select and double click on the Flex Jr.™ icon (Fig. 6) on the desktop to start the FlexSoft® Flex Jr.™ software. A main display window will appear (see Fig. 8).

Figure 6. Flex Jr.™ icon

3.2 USING THE FLEX JR.™ TUTORIAL

In the **Help** menu, click on **View Tutorial** to view the Flex Jr.™ tutorial at any time (Fig. 7). The tutorial will appear on the left side of the screen. The tutorial explains the main steps involved in configuring users, creating regimens, and starting regimens. The tutorial will start automatically, as a default setting, when the software is opened. To turn OFF this feature, uncheck the box marked "Show Tutorial at Startup".

3.3 MAIN DISPLAY WINDOW

The main display window (Fig. 8) for each Flex Jr.™ Tension FlexLink® has several features that allow more precise monitoring of the regimen. To access this window, select the appropriate FlexLink® (**FlexLink#n**) from the **Controllers** menu, where "n" is the FlexLink® number to which the regimen will be downloaded. The FlexLink® number can be found on the LCD screen on the front of the FlexLink® controller box.

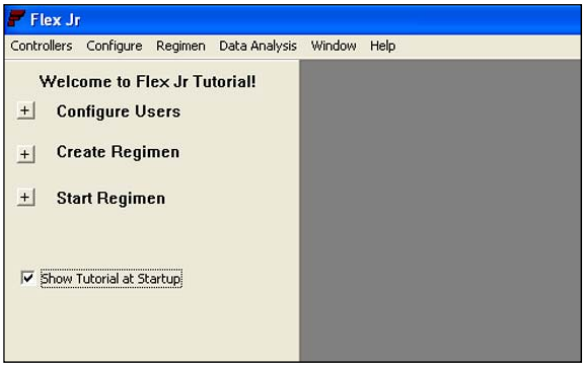


Figure 7. Flex Jr.™ tutorial

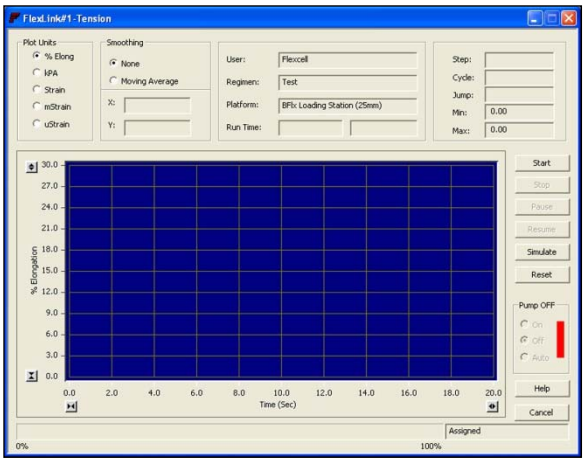


Figure 8. Main display window

<u>All</u> of the remaining information and command button states in the main display window reflect the current state of the system for the currently selected Flex Jr.™ Tension FlexLink®.

It is possible to simultaneously assign and run a different regimen for each of the attached FlexLinks®.

In the upper left hand corner of the window is a section labeled **Plot Units**. This function allows users to change the units of the y-axis: % elongation, kPa, strain,

millistrain (mstrain), or microstrain (ustrain). To select a particular unit, click on the appropriate button beside the unit label.

The next block to the right is a section labeled **Smoothing**. One expects data patterns to represent normal distributions of a function describing a straight line, sinusoidal curve, etc. Therefore, the plotted points of a mathematical function should be a predictable data set that is "smooth" (i.e., a curve comprised of points whose coordinates are predicted by the function). For a straight line, the equation would be $y = mx + b$; for a power function, the equation may be $y = x^2$ or some derivative thereof. In general, data patterns may be confounded with noise. For the case of the pressure plot as a function of voltage from the Flex Jr.™ Tension System pressure transducer, the rough data yield a plot with a coefficient of variation of only 0.01%. Therefore, the signal to noise ratio for the combined Flexcell® system of circuits, hardware and transducers is high, lending confidence in the displayed plot. Nevertheless, the user can select a data smoothing option that is a simple weighted average of the points. The Smoothing section contains the option of either applying no smoothing (**None**) to the data points returned from the FlexLink® or of applying a three-point moving average filter (**Moving Average**) to the incoming data. Choose the desired affect by clicking on the appropriate button.

Below the box for Smoothing is a section used to show the current **X** and **Y coordinates** for the waveform. These are displayed when the left mouse button is clicked and held down in the graph area. When this is done, a pair of crosshairs appears and the coordinates at the intersection of the crosshairs are shown in the X and Y spaces. The crosshairs and values will track the mouse as long as the left mouse button is held down.

The next block to the right is a section used to display the current **User**, **Regimen**, **Platform**, and **Run time**. Run time has two blocks. The one on the left displays the elapsed regimen time, and the one on the right displays the remaining regimen time, using the following format: dd:hh:mm:ss (days:hours:minutes:seconds).

The block at the top right contains the current regimen **Step**, **Cycle**, **Jump** (when a regimen step is using the Jump Back to option), minimum level (**Min**), and maximum level (**Max**). The minimum and maximum levels will be listed according to the units specified under the Plot Units section as the minimum and maximum points at which the membrane stretches with each cycle.

The major portion of the main display window is taken up with a **plot** designed to show the current state of a simulated or running regimen. This plot is generated from the data returned by the FlexLink® during regimen activity. When using a platform configuration that uses vacuum to generate a downward stretching of the membrane (elongation), the vertical scale represents increasing elongation, vacuum or strain. When the selected unit of display is kPa, the vertical scale will start at 0.0 and move upwards as an increasing negative pressure level, indicating that a vacuum is being applied to the membrane to stretch it downwards.

The scale on the x- and y-axes can be changed by clicking on one of the two small double-arrow buttons at either end of the axis. The button with arrows pointing away from each other increases the axis

scale, while the button with arrows pointing toward each other decreases the scale.

Below the plot is a **timeline** that displays the percentage of the regimen that has been completed.

To the right of the plot is a set of command buttons which allow the user to:

1) **Start** a regimen.

2) **Stop** a regimen.

3) **Pause** a regimen.

4) **Resume** a paused regimen.

5) **Simulate** a regimen.

6) **Reset** the controller.

7) Control the vacuum **pump**.

8) Access **Help**.

9) **Cancel** the program.

3.4 CONFIGURING USERS

Prior to creating and downloading a regimen, a user needs to be registered. Once this task is completed, regimens can be personalized under the registered user name.

In the **Configure** menu, select **User Editor**. A new window will appear entitled **Users** (Fig. 9).

To add a user, type in a user name (must be at least 4 characters) in the provided space and click on **Add User**. The new name should appear in the **Existing Users** box.

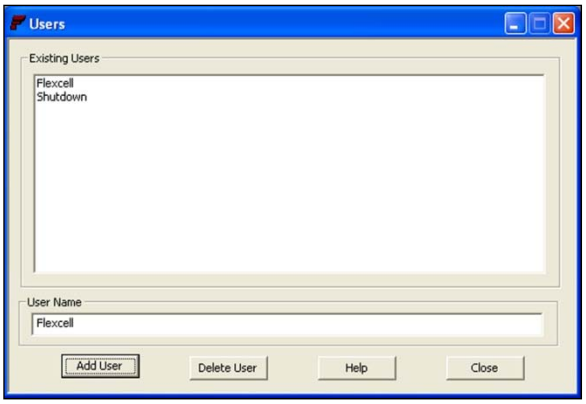


Figure 9. Flex Jr.™ user editor

To delete a user, click on the appropriate user name in the **Existing Users** box so that it is highlighted in blue and then click on **Delete User**. The program will ask for a confirmation and issue a warning, click **Yes** to confirm deletion. The user and any of the user's defined regimens will be deleted.

To exit the Users window, click on **Close**.

3.5 CREATING REGIMENS

Before beginning, a regimen must be created for downloading. In the **Regimen** menu, select **Create new**. A new window will appear entitled **Regimens** with a list of the existing users and their regimens (Fig. 10). In the **Existing Users** box, click on the user name under which the regimen is to be created. A list of current regimens created under this user will appear in the **Regimens for Selected User** box, unless no regimens have been saved under this user, in which case, this box will be empty.

To create a new regimen, click on **Run Wizard** in the bottom left hand corner. This option will bring up a step by step process of creating a new regimen. Alternatively, follow the sequence of steps below:

1) Type a regimen name in the box labeled **Regimen Name**.

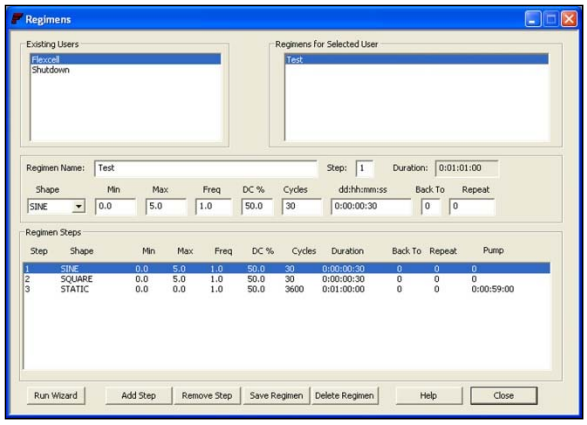

Regimens
Existing Users
Flexcell
Shutdown
Regimens for Selected User
Test
Regimen Name: Test
Step: 1
Duration: 0:01:01:00
Shape Min Max Freq DC % Cycles dd:hh:mm:ss Back To Repeat
SINE 0.0 5.0 1.0 50.0 30 0:00:00:30 0 0
Regimen Steps
Step Shape Min Max Freq DC % Cycles Duration Back To Repeat Pump
1 SINE 0.0 5.0 1.0 50.0 30 0:00:00:30 0 0 0
2 SQUARE 0.0 5.0 1.0 50.0 30 0:00:00:30 0 0 0
3 STATIC 0.0 0.0 1.0 50.0 3600 0:01:00:00 0 0 0:00:59:00
Run Wizard
Add Step
Remove Step
Save Regimen
Delete Regimen
Help
Close

Figure 10. Flex Jr.™ regimen editor

2) Choose the desired waveform shape under **Shape** by clicking on the downward arrow and selecting an entry from the drop-down list.

3) Enter the desired minimum and maximum % elongation for the plate membranes (0-30%) in the boxes under **Min** and **Max**.

4) Enter the frequency for the waveform (0.01-5 Hz) in the box under **Freq**.

5) If a static regimen is required, enter the desired % elongation at which the membrane is to be held in the **Max** box. Enter 0 in the **Min** box, and 1.0 in the **Freq** box (**Min** and **Freq** are irrelevant for static regimens).

6) If a duty cycle for the waveform is to be defined, enter the desired value in the box under **DC %**. The duty cycle is the percent of time that the waveform shape remains on at the high (square wave) or rising (triangle) part of the waveform. Duty cycle only affects the triangle and square waves.

7) Enter the number of times for the regimen to repeat (0-65,535) in the box under **Cycles**. When moving out this box, the box underneath **dd:hh:mm:ss** will update to the calculated regimen time according to the set parameters. Days:hours:minutes:seconds is the format for this entry. However, if the time is entered first, the program will calculate the number of cycles.

8) To make a regimen step (except for the first step) return (jump back) to a previous regimen step, enter the return step number in the box under **Back To**. Then, type the number of times to repeat this process in the box under **Repeat**.

   For instance, if the user was entering Step 4 and wanted to return to Step 2 and repeat Steps 2 through 4 three times, enter 2 under **Back To** and 3 under **Repeat** when inputting Step 4.

9) When the regimen step is complete, click on **Add Step** at the bottom. Every time a new/edited step is saved, the overall duration of the regimen will be calculated and displayed in the box labeled **Duration** next to the **Step** number box. If the total duration exceeds the maximum allowable duration, this value will be **MAXIMUM**, and the regimen cannot be saved. Adjust the time and/or cycle number to decrease the total duration time.

10) To add other steps to a regimen, click in the box labeled **Step** and type in the next step number.

    For example, the first step will automatically be Step 1. To add another step, delete the 1 and replace it with a 2. After this is completed, change the parameters as needed for the new step according to steps 2 to 9 above.

11) To delete a step that has already been added, click on the step in the window labeled **Regimen Steps**, which contains the list of steps. This will cause the step to be highlighted. Then click on **Remove Step** at the bottom of the window. Confirm the deletion by clicking on **Yes** when prompted.

12) After all steps and parameters have been entered, click on **Save Regimen**.

13) To delete a regimen, simply double-click on the desired regimen name in the **Regimens for Selected User** box, and then click on **Delete Regimen**. Confirm the deletion by clicking on **Yes**.

NOTE: *If the regimen to be deleted is currently assigned, the regimen must be removed from assignment before deleting.*

14) When finished with regimen editing, click on **Close**.

3.6 CREATING A REGIMEN WITH A CUSTOM WAVEFORM SHAPE

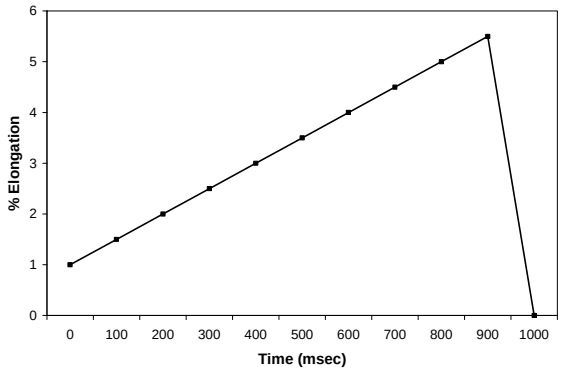
In the top row of an Excel spreadsheet, enter the % elongation values for the desired waveform shape for one cycle. Enter one value per cell. Values should be chosen along a curve at even time intervals, i.e. every 100 msec (milliseconds). Save this spreadsheet as a .csv file (comma delimited file format) in the C:/FlexSyst directory.

Example Excel file: Ramp waveform shape

1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	0

Example CSV file viewed in Notepad: Ramp waveform shape

1,1.5,2,2.5,3,3.5,4,4.5,5,5.5,0



Example Custom waveform shape: Ramp waveform shape

In the **Regimen** menu of the Flex Jr.™ software, select **Create new**. A new window will appear entitled **Regimens** with a list of the existing users and their regimens. In the **Existing Users** box, click on the user name under which the regimen is to be created. A list of current regimens created under this user will appear in the **Regimens for Selected User** box, unless no regimens have been saved under this user in which case, this box will be empty.

To create a new regimen, click on **Run Wizard** in the bottom left hand corner. This option will bring up a wizard to create a new regimen. Alternatively, follow the sequence of steps below:

1) Choose **Custom** from the list of waveform shapes under **Shape** by clicking on the downward arrow and selecting this entry from the drop-down list.

2) Choose the appropriate file name under **File** by clicking on the downward arrow

and selecting an entry from the drop-down list

3) Type a regimen name in the box labeled **Regimen Name**.

4) Enter the time interval in milliseconds between two % elongation values in the box under **Time**.

5) Enter the number of times for the regimen to repeat (0-65,535) in the box under **Cycles**.

6) When the regimen step is complete, click on **Add Step** at the bottom. Every time a new/edited step is saved, the overall duration of the regimen will be calculated and displayed in the box labeled **Duration** next to the **Step** number box. If the total duration exceeds the maximum allowable duration, this value will be MAXIMUM, and the regimen cannot be saved. Adjust the time and/or cycle number to decrease the total duration time.

7) Click on **Save Regimen**.

8) When finished with regimen editing, click on **Close**.

3.7 ASSIGNING REGIMENS

In the **Controllers** menu select the appropriate **FlexLink#n**, where "n" is the FlexLink® number to which the regimen will be downloaded.

In the **Regimen** menu, select **Assign,** then choose the **Platform**, **User**, and **Regimen** from each drop down menu (Fig. 11). A message box will appear to confirm regimen assignment. Click **Yes**.

NOTE: Be sure to choose the platform that properly corresponds to the setup being used, otherwise the % elongation values will be incorrect.

For example:

*If using the StageFlexer with a 25 mm diameter Loading Station™, click on **SF Loading Station (25mm)** for the choice of platforms.*

*If using the StageFlexer Jr. with a 18.5 mm diameter Loading Station™, click on **SF Jr. Loading Station (18.5mm)** for the choice of platforms.*

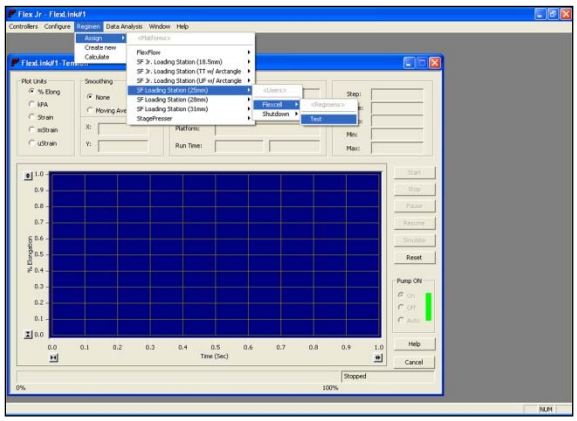


Figure 11. Assigning regimens for downloading to the Flex Jr.™ Tension FlexLink®.

If the download progresses, no further messages will appear, and the **Start** and **Simulate** buttons will be enabled. If an error occurred in downloading the regimen to the FlexLink®, a message will appear alerting the user of a problem, and the regimen will not be able to run. In which case, click **Reset** in the FlexLink® window, and then assign the desired regimen again.

3.8 STARTING REGIMENS

To run an assigned regimen, click on **Start** in the main display window (Fig. 8) after the regimen has finished downloading. Be sure that the vacuum pump is ON and all other connections are made. The membranes should begin flexing, and the assigned regimen will be in progress.

The progress of the regimen for the currently selected FlexLink® will be monitored continuously. The displays for Run Time, Step #, Cycle #, Jump #, and Min and Max % will update, as will the ***actual waveform data*** returned by the FlexLink®. Additionally, a progress bar below the graph will display the percentage of the regimen that has been completed.

3.9 SIMULATING REGIMENS

The **Simulate** button is used to simulate a regimen graphically without actually running it. Simulating a regimen will give the user an idea of the waveform output before actually running the regimen. To start a simulation, click on **Simulate** in the main display window. A waveform will begin moving across the graphic display. This waveform corresponds to the ideal waveform as generated by the Flex Jr.™ software, and is the actual waveform pattern sent to the FlexLink® during the download process. For certain waveforms (e.g. square waves), the idealized pattern may appear to have some unusual elements (e.g. rounded corners). The purpose of these unusual elements is to accommodate for the lag time during sudden changes in pressure (e.g. rising/falling edge of a square wave). Without these unusual elements, the valve controllers may oscillate for a period of time (e.g. dampened sine wave during beginning of plateau in a square waveform).

3.10 PAUSING REGIMENS

To pause a simulated or running regimen, click on **Pause** in the main display window. Click on **Yes** when the program asks for confirmation. Pausing will cause the current simulation or actual running of the regimen to stop at the next cycle of the current regimen step. Pausing is different from stopping, in that pausing leaves the regimen at its current position, whereas stopping

causes the regimen position to be set to the beginning of the first regimen step.

3.11 RESUMING REGIMENS

To resume a paused regimen, click on **Resume** in the main display window. This function is available only when a simulated or running regimen has been paused. The regimen will restart its prior activity (simulation or actual run) from its last point.

3.12 STOPPING REGIMENS

To stop a simulated or running regimen, click on **Stop** in the main display window. Click on **Yes** when the program asks for confirmation. Stopping causes the current activity to cease immediately, and sets the regimen position back to the beginning of the first regimen step. Stopping is different from pausing, in that pausing leaves the regimen at its current position so that it can be resumed from where it paused.

3.13 DETERMINE THE PROGRESS OF THE REGIMEN

The progress of the regimen for the currently selected FlexLink® will be monitored continuously. The displays for **Run Time**, **Step** number, **Cycle** number, **Jump** to number, and **Min** and **Max** % elongations will be updated in the upper right hand corner of the main display window. The actual waveform data returned by the controller will also be continuously updated on the graph. A timeline progress bar below the plot illustrates the percent of the regimen that has been completed.

3.14 RESETTING THE FLEXLINK®

Resetting a simulated or running regimen causes the current activity to stop at the next cycle of the current regimen step, and disassociate the regimen from the FlexLink® controller. To reset, click on **Reset** in the main display window. Click on **Yes** when the program asks for confirmation. The system will now be in state similar to that which exists when the Flex Jr.™ Tension FlexLink® is first turned ON.

3.15 CONTROLLING THE VACUUM PUMP

On the right side of the FlexLink® window, the box labeled **Pump** allows the user to control power to the vacuum pump.

NOTE: *The vacuum pump must be plugged into the back of the Flex Jr.™ Tension FlexLink® in the appropriate 110/220V plug prior to system power-up for this option to work, and the ON/OFF switch on the vacuum pump must be in the ON position.*

For manual control of the pump through the FlexLink®, use the **On** and **Off** options. If **On** is selected, the FlexLink® will turn the pump ON. If **Off** is selected, the FlexLink® will turn the pump OFF. For automatic control of power to the pump while regimens are running, select **Auto** prior to downloading the regimen. Once **Auto** is selected, the FlexLink® will turn the pump ON. The software will turn the pump OFF when a regimen is complete. This option also allows the pump to be turned OFF during a regimen step when a static waveform regimen is selected that has a 0% maximum elongation longer than 60 minutes. The pump will power up 10 minutes before the next regimen step begins. Users will be prompted to select this option or not when creating a regimen. The status of the pump is indicated by a light box to the right side of the

On/Off/Auto options. A green light indicates that the pump is ON, and a red light indicates that the pump is OFF.

3.16 DATA ANALYSIS

The Flex Jr.™ software has the capability of storing data (a set of waveform points) from a regimen run to a file on the hard drive. The filename consists of the FlexLink® number, a "V" or "C" code letter (*V* for vacuum, or *C* for compression), the regimen name and a sequence number. If a tension regimen is run three times on FlexLink#1, then there will be three data files on the hard drive with numbers '000', '001' and '002', respectively (i.e., 1_V_regimenname_001.dat, 1_V_regimenname_002.dat, etc.). The file size depends on the regimen duration. The current settings take pressure data every 2 milliseconds (i.e., 500 points/sec or 1,800,000 points/hour). Therefore, a one hour regimen will have approximately a 4.0 Mb data file. To turn this feature OFF, please contact Flexcell®.

To see the stored data, in the **Data Analysis** menu, select **Data Viewer**. Open the appropriate .dat file from the C:/FlexSyst directory. Two new windows will appear (Fig. 12). In the window labeled **filename:1**, the data presented defaults to the raw data. In the window labeled **filename:2**, the data presented defaults to a moving average of the raw data with data averaged every 10 seconds.

The **y-Axis control** box allows for automatic or manual control of the scale on the y-axis. If **Auto** is selected, the y-axis scale can be changed by clicking on one of the two small double-arrow buttons at either end of the axis. The button with arrows pointing away from each other increases the axis scale, while the button with arrows pointing toward each other decreases the scale. The minimum value is -2 kPa and the maximum is -100 kPa. If **Manual** is selected, the user can enter the upper and lower limits of the y-axis scale in the white boxes to the left side of the axis. The small double-arrows will not function if **Manual** is selected.

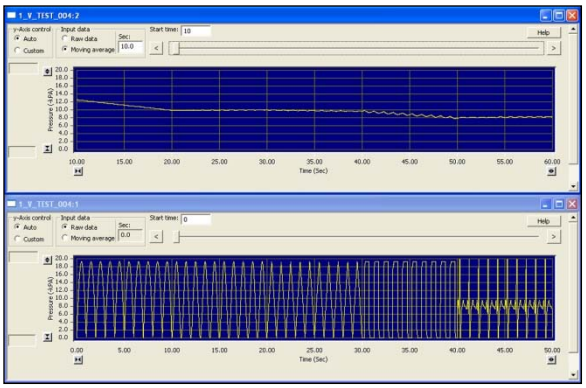


Figure 12. Flex Jr.™ data display

The **x-axis scale** allows for a time interval to be set between 0.1 and 1000 seconds. Click on one of the two small double-arrow buttons at either end of the axis to change this scale. The button with arrows pointing away from each other increases the axis scale, while the button with arrows pointing toward each other decreases the scale.

The **Input data** box allows the user to switch the data in the graph from raw data to averaged data. If the **Raw data** option is selected, the graph will plot the ¯kPa pressure over time, in seconds, for the selected regimen. If the **Moving average** option is selected, the graph will plot the average pressure over the designated time period (in seconds, range of 0.1-1000 seconds) shown in the **Time (s)** box.

The **Start time** box can be set so that the data viewed in the plot begin at the specified time entered here. Use the timeline at the top of the graph to navigate through the regimen. Users can move the slider function within the timeline to

manually progress through the regimen plot. If the user clicks on the arrows at either end of the timeline, the plot will progress to the next time period as set by the x-axis scale. For instance, if the scale is set to show 20 seconds of data and the user clicks on the right arrow button, the plot will progress to the next 20 seconds of data.

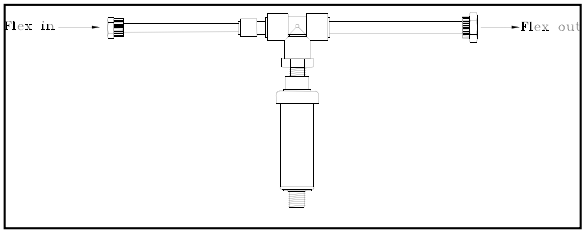


Figure 13. System Drying Filter

3.17 SHUTTING DOWN THE SYSTEM

A system **Drying Filter** (Fig. 13) has been supplied with the Flex Jr.™. This device must be used whenever the system has been operated for more than one day and will not be operated again for more than one day. If the system will be operated again immediately after a one-day run or if the regimen runs for a longer period of time, the Drying Filter can be used at the conclusion of the usage period. The device and shutdown program will help to remove any moisture entrained into the valves during normal operation. This will greatly prolong the life of the valves and reduce expensive repairs.

To use the Drying Filter, first remove the orange plug in the bottom of the filter. Attach the fittings of the Drying Filter to the proper ports on the rear of the FlexLink® by replacing the lines running to the microscope device (***FLEX IN*** and ***FLEX OUT***). Assign the ***Drying*** regimen under the ***Shutdown*** user, using the ***SF Loading Station (25mm)*** platform.

If the ***Drying*** regimen is not in the system or is erased, create a regimen with the following specifications: sine wave, 0-28%, 0.5 Hz, 1000 cycles; all other parameters are standard. The shutdown program will run for about 30 minutes. Dry room air will help to reduce moisture entrained into the lines and valves from the atmosphere. Once the beads in the Drying Filter become pink, the filter is saturated and needs to be replaced.

3.18 EXITING THE FLEX JR.™ PROGRAM

To exit the Flex Jr.™ software, in the **Controllers** menu, select **Exit**.

4. ADDENDUMS TO THE FLEX JR.™ TENSION SYSTEM

FOR OPTIMAL PERFORMANCE OF THE TENSION UNIT:

A. Place the FlexLink® higher than the microscope device. This will reduce the amount of moisture reaching the valves in the system.

B. It is necessary to place the included Water Traps inline between the FlexLink® and the microscope device. Be sure to place the Water Traps **below** the Flex Jr.™ Tension FlexLink®. Humid air from the incubator tends to condense within the tubing lines. This moisture may in turn lead to problems with long term regimens. This fluid collection can be prevented from entering the FlexLink® by the insertion of the Water Traps.

   The Water Traps need to be placed so that they are maintained in a **vertical position**. They should be checked frequently (twice a day initially while a regimen is running) and should be emptied when the Water Traps become half full. On the first trial, monitor the Water Traps every 15 minutes for the first two hours to be sure that a significant amount of water is not accumulating. If so, there may be a leak in the platform and/or gasket/BioFlex® plate assembly. See "System Troubleshooting, Problem 1" (pg. 18) to correct this problem. The valves and transducers may be damaged if moisture is allowed to accumulate.

C. Use the system Drying Filter and the shutdown program whenever the unit has been operating continually for more than one day and will not be operated again for more than one day. See section 3.17 for instructions.

D. Make sure that the brass fittings on the back of the unit are tight and that the tubing is secure.

E. Achieving the highest possible combinations of % elongation and frequency:

   a) Shorten the ***FLEX IN***, ***FLEX OUT***, and ***SYSTEM*** tubing to their minimum possible lengths. See section 2.2 for minimum lengths.

   b) Use a more powerful vacuum source if recommended specs are not being reached with the current vacuum source (see section 2.4).

5. SYSTEM TROUBLESHOOTING

NOTE: *If the Flex Jr.™ system is not functioning properly and the solution is not clearly outlined or defined below, please contact Flexcell® before attempting any repairs.*

Problem 1: Regimen wave is flatlining

Solution 1:

Remove the *SYSTEM* vacuum line at the back of the FlexLink® and check to be sure that there is vacuum coming through the line. Check the ***VENT*** port at the back of the FlexLink® when the system is running to see if air is moving in or out. If not, it is possible that the valves are locked due to residue buildup. Try applying positive pressure to the ***VENT*** port to free the valves.

If the regimen wave is flatlining but the plates are still cycling air pressure, try the following:

Disconnect the blue 1/4" (6.4mm) *FLEX IN* tubing from the back of the unit and place a finger over the end of the tubing while a regimen is running. If air is cycling at the end of the tubing then the problem is with the Flex Jr.™ Tension FlexLink®. Contact Flexcell® International for further instructions.

Problem 2: Regimen wave is fluttering or not smooth

Solution 2:

This problem could be due to water in the valves or miscalibration. Run the drying regimen with the Drying Filter (as described in the manual) to dry the system and valves. If this does not resolve the problem try running the drying regimen once more. If the problem continues, contact Flexcell® for further instructions.

Problem 3: Programming a long regimen (1 day or more) but the software will not allow the regimen to be saved.

Solution 3:

The software has a limit on the number of cycles that can be entered into any given step (65,535). If a regimen is programmed with a step that requires more than 65,535 cycles, the software will give an "invalid entry" error. To run the regimen for the time required additional steps will need to be programmed. This will not create any breaks in the regimen. Simply divide the total time in half (or as many times as is necessary) and make additional steps with the same parameters. See section 3.5 of the manual for instructions on programming additional steps.

Problem 4: "An invalid argument was encountered" error is shown when attempting to assign a regimen.

Solution 4:

This problem is caused when a user name is entered into the software without any regimens listed under his/her name. If the assign function sees that a user has nothing to assign an error is displayed. Simply delete the user(s) without a regimen or make and save a regimen under the user(s) name(s).

Problem 5: Water is accumulating quickly in the Water Traps

Solution 5:

This problem is likely due to a poor gasket seal on the BioFlex® baseplate. See the solution to Problem 1 to correct this. Be sure to empty the Water Traps frequently if this problem occurs. Water accumulation in the FlexLink® can damage the valves.

Problem 6: Cells are not attaching properly to the growth surface or are detaching during stretching

Solution 6:

This problem can be caused by plating too many cells. Try plating with a lower cell density—if the cells are not confluent, they will form a matrix with the collagen (or other matrix coating), attaching more securely to the growth surface. Also, check with Flexcell® to be sure that the best matrix coating for attachment of the particular cell type is being used.

Problem 7: One or more of the FX5K™ Tension FlexLinks® connected to the system are not being recognized by the software. This is usually represented by the error message "Cannot Connect to Controller" when attempting to connect a FlexLink® to assign a regimen.

Solution 7:

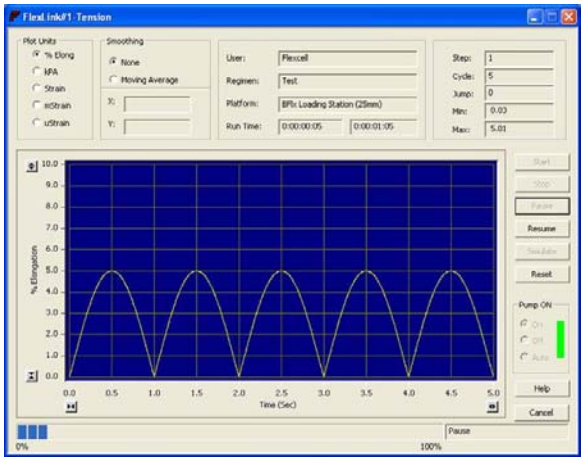
This problem is usually due to a lack of communication between the computer and one or more FX5K™ Tension FlexLinks®. Check the FX5K™ Tension FlexLink® Ethernet port connection on the computer and the communications connection on the back of the FlexLink® to be sure that these are secure. Check the FlexLink® to see if the power is ON (the FlexLink screen should power on). If both of these conditions are true, close and restart the software. Try downloading the regimen again. If the problem is not resolved, call Flexcell® for further instructions

6. APPLICATION NOTES

WAVEFORM SHAPE DEFINITIONS

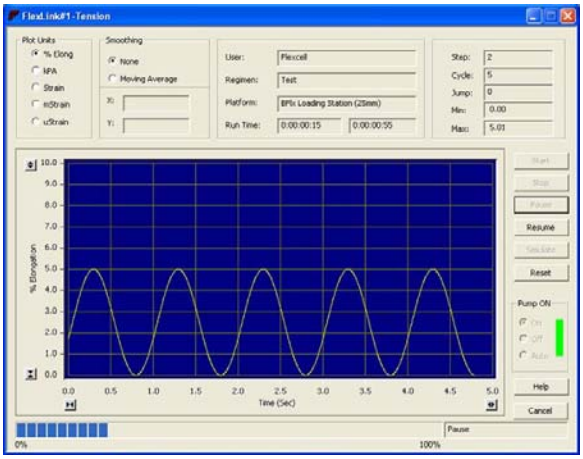
½ Sine Wave

This waveform provides a smooth, physiological variation in pressure at the max% with a quick transition at the min%.



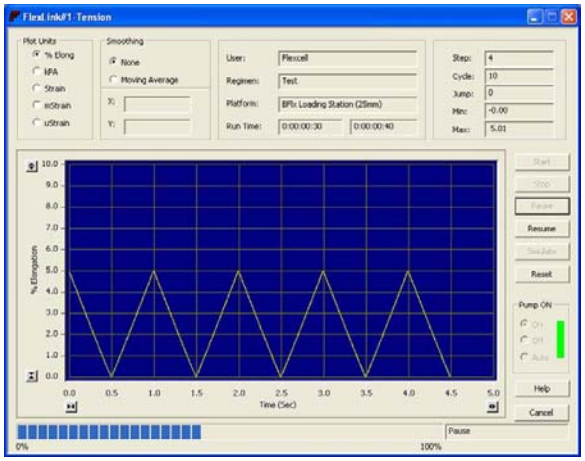
Sine Wave

This waveform provides a smooth, physiological variation in pressure from min% to max%.



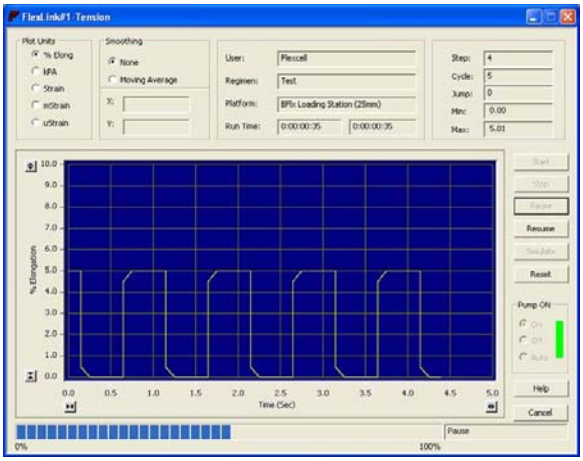
Triangle Wave

This waveform provides a linear-ramped rise to the max% and a linear-ramped fall back to the min%.



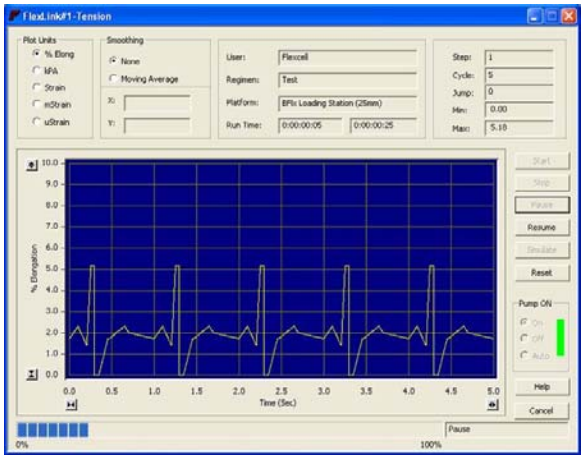
Square Wave

This waveform provides the fastest possible rise to max%, followed by the fastest possible fall to min%.



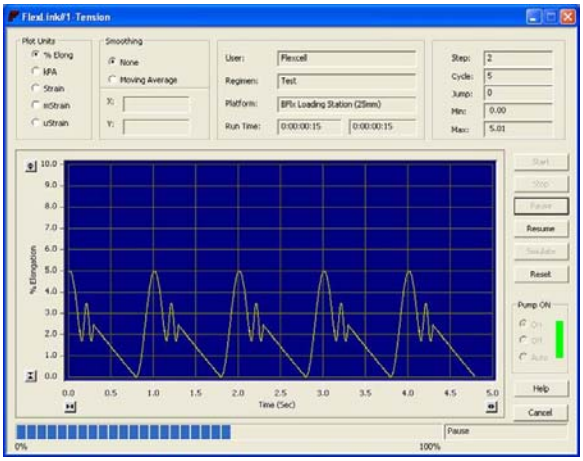
Heart (E) Wave

This waveform applies a pressure pattern that mimics the shape as seen on an electrocardiogram



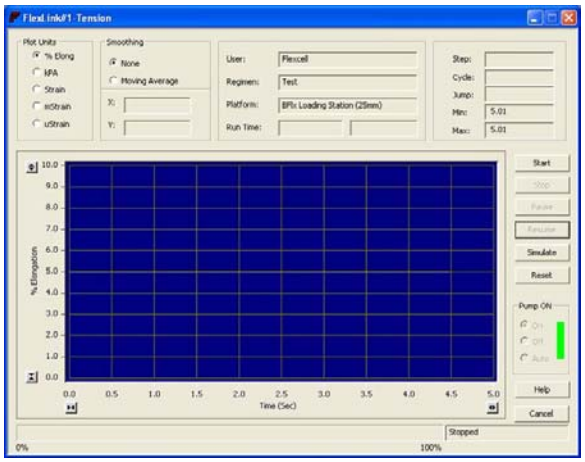
Heart (P) Wave

This waveform applies a pressure pattern that mimics the actual pressure wave generated by a heart beat.



Static Wave

This waveform applies a constant state of pressure.



FLEXCELL® FLEX JR.™ TENSION SYSTEM SPECIFICATIONS

FLEX JR.™ TENSION SYSTEM FEATURES

- Uses vacuum to deform a flexible membrane yielding up to 17% substrate elongation
- Minimum strain resolution capability is 0.1% elongation
- Applies a defined, controlled, static, or cyclic deformation to cells *in vitro*
- Housed valving mechanism automatically regulates and maintains pressure to provide the specified strain regimen
- Capable of driving up to 4 independent FlexLink® remote strain and/or compression controllers
- Capable of delivering frequency ranges from 0.01→5 Hz
- Works with StageFlexer®, StageFlexer® Jr., and FlexFlow™ devices
- Ability to program multiple frequency, amplitude and wave changes in one regimen
- Waveforms available: Static wave, Sinusoidal wave, Heart wave (Electronic and Pressure), Triangular wave, Square wave and custom waveforms
- Provides equibiaxial strain to the StageFlexer® membrane and equibiaxial or uniaxial strain to membranes cut-out of BioFlex®, UniFlex®, or Tissue Train® culture plates.
- *Optional:* StageFlexer® and StageFlexer Jr.® devices allow strain application to cells while viewing in real time under an upright microscope

FLEX JR.™ TENSION COMPONENTS AND SPECIFICATIONS

- Dell OptiPlex Desktop Computer
- USB Keyboard
- USB Mouse
- 17" Flat panel Monitor
- FlexSoft® (Flexcell® Flex Jr.™ Software) and Microsoft Windows 7
- Flex Jr.™ Tension FlexLink® controller
- Accessory Pack - nuts, ferrules
- Water Trap (x2)
- System Drying Filter
- Silicone lubricant
- 25 ft Blue tubing (¼" (6.4 mm) O.D.) for ***FLEX IN*** connection
- 25 ft Clear tubing (⅜" (9.5 mm) O.D.) for ***FLEX OUT*** connection
- 25 ft Blue tubing (⅜" (9.5 mm) O.D.) for vacuum source connection
- Flexcell® Flex Jr.™ Tension System User's manual, Vacuum Source Connection Manual, Water Trap and Drying Filter Tech Report and other ancillary manuals for computer and monitor
- Surge protected power outlet strip

FLEX JR.™ TENSION COMPUTER SPECIFICATIONS

- OptiPlex Small Form Factor
- Intel Core i5 processor (3.2 GHz)
- 250 GB SATA 6.0 Gb/s hard drive
- DVD +/- RW Drive
- 2 GB of DDR3 RAM
- Integrated video, Intel® HD2500

Operating System:

- Microsoft Windows 7 Professional

FLEX JR.™ TENSION FLEXLINK® COMPONENT SPECIFICATIONS

- Custom design vacuum controller board
  - Microprocessor sampling rate for display data transducer: 200 Hz
  - Microprocessor sampling rate for feedback/error (valve adjustment) transducer: 1 KHz
- 2 proportional-solenoid valves
- Ethernet port (RJ45)

FLEX JR.™ TENSION FLEXLINK® CALIBRATION SPECIFICATIONS

Unconstrained Static Performance (low side transducers):

Maximum allowable waveform variance from static line: ± 0.25% elongation
Maximum % elongation error (actual vs. programmed): +/-0.6% elongation
Maximum allowable transducer inaccuracy: +/-1.0 kPa

Unconstrained Dynamic Performance (low side transducers):

Maximum % elongation error (actual vs. programmed): +/- 0.5% elongation, at the following frequencies: <5% elongation, 0.5 and 1.0 Hz; 10 % elongation, 0.5 and 0.75Hz; >10% elongation, 0.5 Hz
Maximum allowable transducer inaccuracy: +/-1.0 kPa

BioFlex 25mm Loading Station Static Performance (high side transducers):

Maximum allowable waveform variance from static line: +/- 0.25% elongation
Maximum % elongation error (actual vs. programmed): +/-0.5% elongation
Maximum allowable transducer inaccuracy: +/-2.0 kPa

BioFlex 25mm Loading Station Dynamic Performance (high side transducers):

Maximum % elongation error (actual vs. programmed): +/-0.75% elongation, at the following frequencies: ≤15% elongation, 0.5 and 1.0 Hz; >17.5% elongation, 0.5Hz
Maximum allowable transducer inaccuracy: +/-2.0 kPa

LOADING STATIONS™ SPECIFICATIONS

StageFlexer® 25mm Diameter Loading Stations™ (equibiaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 1.6%
Maximum achievable % elongation with the Flex Jr.™: 14.8%

StageFlexer®28mm Diameter Loading Stations™ (equibiaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 1.9%
Maximum achievable % elongation with the Flex Jr.™: 13.4%

StageFlexer®31mm Diameter Loading Stations™ (equibiaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 2.1%
Maximum achievable % elongation with the Flex Jr.™: 8.6%

BioFlex® membrane with 18.5mm Diameter Loading Stations™ (equibiaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 1.8%
Maximum achievable % elongation with the Flex Jr.™: 13.8%

Tissue Train® membrane with Arctangle® Loading Stations™ (uniaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 2.5%
Maximum achievable % elongation with the Flex Jr.™: 17.7%

UniFlex® membrane with Arctangle® Loading Stations™ (uniaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 1.5%
Maximum achievable % elongation with the Flex Jr.™: 7.9%

FlexFlow™ (equibiaxial strain):

Minimum achievable % elongation with the Flex Jr.™: 0.8%
Maximum achievable % elongation with the Flex Jr.™: 4.3%

FLEX JR.™ TENSION PHYSICAL SPECIFICATIONS

Flex Jr.™ Computer:	Size, W x H x D:	3.65" x 12.45" x 13.40" (9.3 x 31.6 x 34.0 cm)
	Power Requirements:	115/230V –8.8/4.3A or 4.3/2.2A – 60/50 Hz
	Weight (unit only):	15.0 lbs (6.8 kg)
Flex Jr.™ Tension FlexLink®:	Size, W x H x D:	9.4" x 7.0" x 15.6" (23.9 x 17.8 x 39.6 cm)
	Power Requirements:	115/230V – 6/3A – 60/50 Hz
	Weight (unit only):	17.70 lbs (8.03 kg)
Monitor 17"LCD Flat Panel:	Size, W x H x D:	14.6" x 15.7" x 7.1" (37.1 x 39.7 x 18.0 cm)
	Power Requirements:	115V - 60 Hz Auto switch to 230 V
	Weight (unit only):	11.22 lbs (5.1kg)

FLEX JR.™ TENSION VACUUM REQUIREMENTS

To achieve the maximum system capability, the minimum vacuum source requirements are:

- Maximum Vacuum: : -100 kPa
- Free Airflow Rate: 5.7 cfm (161 L/min)

NOTICE

The information in this document is subject to change without notice. Flexcell® International assumes no responsibility for any errors that may appear in this guide. This manual is believed to be complete and accurate at the time of publication. In no event shall Flexcell® International Corporation be liable for incidental or consequential damages in connection with or arising from the use of the manual. Opening the case of the Flex Jr.™ Tension FlexLink® voids the warranty. Customers must contact Flexcell® International Corporation or an authorized distributor before opening the case on the Flex Jr.™ Tension FlexLink®.